NOAH PRECISION, LLC

MOCVD

Temperature Control System

Model therMOstat 500

Manual Rev 1, July 14

A message to our customers:

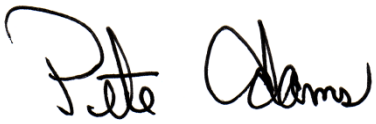
Originally founded in 1985, our company has grown into a recognized leader in providing temperature-control systems to the global semiconductor industry.

Today, Noah Precision, LLC is a privately held, employee owned and managed company. We are guided in our belief that prosperity in this competitive industry stems from providing customers with highly engineered new products and world class customer service.

We know that great products are often the result of great customer feedback and the application of innovative technology. We strive to create value for our customers through a process that lets the customer influence our goals, objectives, product developments and business practices.

We embrace personal accountability and accept responsibility for prudent risk taking. We encourage personal values, which guide us to consistently meet the commitments we make and we endeavor to treat those with whom we interact with respect as we wish to be treated ourselves.

Sincerely,



Peter Adams, President

Noah Precision, LLC

COPYRIGHT

This manual and the information contained herein is the proprietary property of Noah Precision, LLC.

No part of this manual may be reproduced or copied without the express written permission of Noah Precision, LLC. Any unauthorized use of this manual or its contents is strictly prohibited. Copyright © 2004-2007 Noah Precision, LLC. All Rights Reserved.

DISCLAIMER AND LIMITATION OF LIABILITY

The information contained in this manual is subject to change by Noah Precision, LLC without prior notice. Noah Precision, LLC makes no warranty of any kind whatsoever, either expressed or implied, with respect to the information contained herein. Noah Precision, LLC shall not be liable in damages, of whatever kind, as a result of the reliance on or use of the information contained herein.

PRODUCT USAGE STATEMENT

DANGER:

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or maintaining this equipment. Practice all plant and product safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. All personnel who work with or who are exposed to this equipment must take precautions to protect themselves against serious or possibly fatal bodily injury.

Noah Precision, LLC, provides information on its products and associated hazards, but it assumes no responsibility for the after-sale operation of the equipment or the safety practices of the owner or user. This equipment produces or uses potentially lethal high-voltage, high-current, electrical power. NEVER DEFEAT INTERLOCKS OR GROUNDS.

TRADEMARKS & PATENTS

logo is a registered trademark of Noah Precision, LLC

Noah Precision ® is a registered trademark of Noah Precision, LLC
Point of Use™ is a trademark of Noah Precision, LLC
therMOstat 500 patent # 8,118,939

CUSTOMER FEEDBACK

Noah Precision's technical writing staff has carefully developed this manual using research-based document design principles. However, improvement is ongoing, and the writing staff welcomes and appreciates customer feedback. Please send any comments on the content, organization, or format of this user manual to

- hr@noahprecision.com

To order a manual, please contact Noah Precision (see "Customer Support Locations" on page 6-3 for contact information).

Contents

Chapter 1 - Components List 9
thermostat 500 9
Power cable 9
Fill Canister 10
Chapter 2 - Facility Requirements 11
General specifications 11
PCW (Process Cooling Water) 11
Mounting 12
therMOstat 500 12
therMOstat 500 Dimensions 12
Chapter 3 - Bubbler and Fill Procedure 13
Bubbler Installation 13
Bubbler Removal 14
Fill, Prime, and Drain Procedure 15
Fill Procedure 15
Pump Priming Procedure 15
Drain Procedure 16
Chapter 4 - Cable Connections 17
Chapter 5 - Operation 18
Operational States 19
Idle mode 19
Active mode 19
Front Panel 19
System Start-Up 19
Step-by-step instructions for normal operation: 19
Controller Setup/Operation 20
Parameter Descriptions: ..... 20 & 21
Manual Tuning Procedure for the Controller 22
Setting DeviceNet Address and Baud Rate 22

Configuring 485 / Modbus addressing 22
Analog Voltage Output Function 23
Signal Interface 23
Pin Out 23
Calibrating the Analog Voltage Output Signal 23
DeviceNet Operation 234
DeviceNet Scanner Status / Error Codes 234
Chapter 6 - Maintenance 265
Chapter 7 - Troubleshooting 266
Types of Alarms 26
Soft Alarm 26
Hard Alarm 26
Troubleshooting 26
Troubleshooting Guide 267
Noah Precision World Wide Web Site 27
Noah Precision Customer Support 28
Returning Units for Repair 28
Warranty 29
Warranty Statement 29

List of Figures

Figure 1-1 *therMOstat 500 Front Panel* 7
Figure 1-2 *Veeco C13 to C20 plug* 10
Figure 1-3 *Fill Canister for the therMOstat chiller line* 10
Figure 2-1 *Dimensions of the therMOstat 500* 12
Figure 3-1 *Sizing kit Diagram* 13
Figure 3-2 *A:Sizing kit (clamp band hole) installed on B: Adapter Plate mounted to C: Top Plate. Second picture is flange mounted for 6.6" Bubbler.* 14
Figure 4-1 *Communiations plate sans DeviceNet.* 17
Figure 4-2 *Communications plate with DeviceNet.* 17
Figure 5-1 *Calibration Offset* 23

List of Tables

Table 1	*General Specifications for the therMOstat*	11
Table 2	*PCW (Process Cooling Water) Specifications*	11
Table 3	*Control Panel Indicators*	18
Table 4	*Watlow Controller description*	18
Table 5	*Watlow Controller Operation Parameters*	20
Table 6	*Pin out description*	23
Table 7	DeviceNet Module Status (MS) light table.	24
Table 8	DeviceNet Network Status (NS) light table.	25
Table 9	*Troubleshooting Guide*	27
Table 10	*Customer Support locations*	28

Chapter 1 - Components List

THERMOSTAT 500

The therMOstat 500 is a thermoelectric (TE) based, sealed chiller which provides temperature control for a bubbler that is installed within the module. The module is space efficient, water cooled, and has PID temperature control. An internal pump circulates a cooling medium within the module for optimum heat transfer and temperature control.

*Figure **1-1***

POWER CABLE

The therMOstat 500 has a C13 IEC filtered power inlet on the back of the unit. This can connect to a various amount of connectors, such as C20 plug for Veeco systems, the custom Aixtron connector, or even an American NEMA 5-15 plug.

*Figure **1-2** Veeco C13 to C20 plug*

FILL CANISTER

A manually pressurized fill canister is available for filling the therMOstat module with a cooling medium of choice. See *Figure **1-3***

*Figure **1-3** Fill Canister for the therMOstat product line*

Chapter 2 - Facility Requirements

GENERAL SPECIFICATIONS

Table 1 General Specifications for the therMOstat

Description	Specification
AC Supply Power	Maximum: 1000 Watts
Power Line Frequency	50/60 Hz
Line Voltage	90 – 250 VAC, auto-ranging
Inlet Socket	According to IEC/EN 60320-1/C13ii
Power Cord	Veeco (p/n: 275-3606), Aixtron (p/n:275-3612)
Cooling Capacity	500 watts @ 20 °C
Heating Capacity	1000 watts @ 20 °C
Temperature Range	0 °C to +50 °C
Temperature Tolerance	±0.1 °C
Comm. Interface	DeviceNet, RS-485, RS-232, Analog
Chiller Dimensions	12” W x 12” L. x 21” H
Fluid Type	1. Distilled water. 2. Glycol-water mixture 3. Perfluorinated fluid (requires TMO-500-F)
MTBF Target	≥ 30,000 hrs.

PCW (PROCESS COOLING WATER)

Table 2 PCW (Process Cooling Water) Specifications

Description	Specification
Flow Rate	≥ 1.0 GPM (3.8 lpm), minimum
Temperature	≤ 25°C
Water Pressure	50 to 80 psi (30 psi min delta) 340 to 550 kPa (210 kPa min delta)
Filtering	5 micron particle filtered water recommended
Fittings	Stainless Steel Swagelok Tube Fitting, Compression fitting, 3/8 in. Tube OD (Adapter to ½” barb fitting available.

MOUNTING

therMOstat 500

Orientation: Module must be upright.

Location: Install in a location where the fittings and electrical connections are accessible.

Clearance: Minimum 4” surrounding module for water and electrical connections.

therMOstat 500 Dimensions

Below are the physical dimensions for the therMOstat 500 with the handles folded down, see *Figure 1-3***2-1**.

Note: The figure below shows the height dimension with the handles *down*.. The width dimension shows the handles *down*.

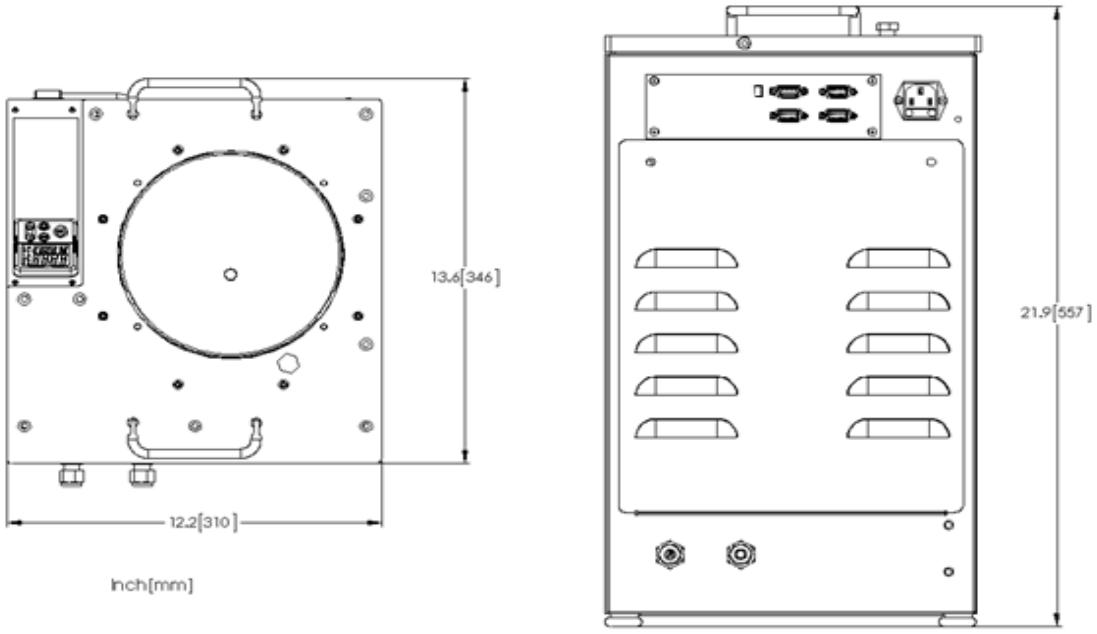


*Figure **2-1** Dimensions of the therMOstat 500*

Chapter 3 - Bubbler and Fill Procedure

Bubbler Installation

The therMOstat is configured from the factory in an open bath configuration. Sizing kits are available to accommodate various sizes including 2 to 6.6 inch diameter and up to a triple 2.2 inch diameter bubbler configuration. Refer to the Sizing Kits section of this chapter for sizing kit installation instructions. Contact Noah Precision for other sizing kit opportunities.

ITEM NO.	DESCRIPTION
1	Bubbler
2	Sizing Kit
3	Clamp driver
4	Bubbler O Ring
5	Sizing Flange or Adapter plate
6	O Ring for Sizing Flange or Adapter Plate

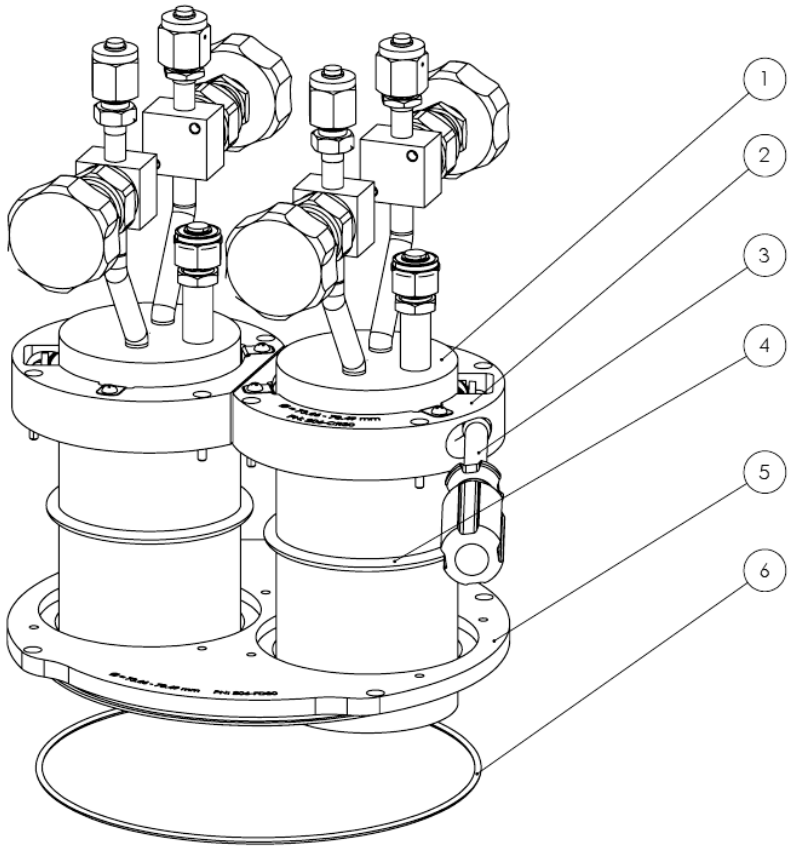


*Figure **3-1** Sizing kit Diagram*

Follow the procedure below for basic bubbler and sizing kit installation:

1. Loosen the bubbler clamp band by using a flat heat or socket head driver to allow for bubbler installation, see *Figure **3-2***.
2. Insert bubbler into the therMOstat 500 chamber.
3. Adjust bubbler for proper height/location. The o-ring may temporarily hold it in place.
4. Tighten the bubbler clamp band to secure the bubbler into its final placement.

CAUTION:
Always use proper precaution when working with gases. This should be done by a trained and qualified technician.

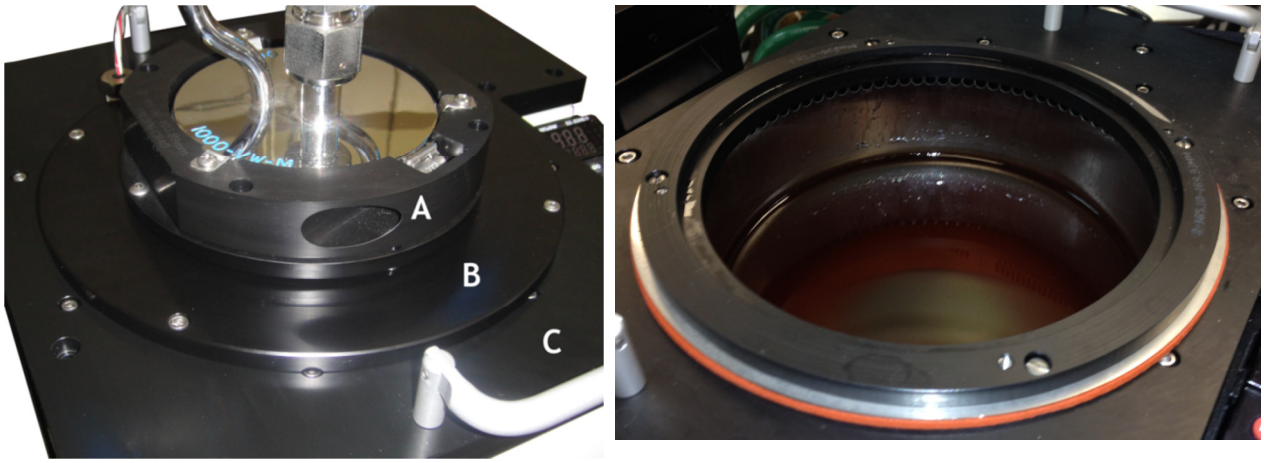


*Figure **3-2** A: Sizing kit (clamp band hole) installed on B: Adapter Plate mounted to C: Top Plate. Second picture is flange mounted for 6.6" Bubbler.*

Bubbler Removal

Follow the procedure below for basic bubbler removal:

Note: If moving to a larger sizing kit or decommissioning, follow "Drain Procedure" on page 16 before continuing.

1. Turn off the therMOstat 500.
2. Assure gas lines are disconnected from the bubbler.
3. Loosen the bubbler clamp band by using a flat heat or socket head driver to allow for bubbler removal, see *Figure **3-2***.
4. Remove the bubbler.

Fill, Prime, and Drain Procedure

Fill Procedure

The required amount of fluid needed to fill the therMOstat will vary depending on the size of the bubbler and sizing kit installed. The fluid level in the therMOstat 500 should always remain between the Low and Full indicators on the front of the unit, see *Figure 1-3***1-1**. See the following steps for fill capacity notification via the therMOstat.

Noah sells a fill canister with a capacity just over 3 gallons (11 liters).

CAUTION:

To prevent overflow, the therMOstat 500 must be filled with the bubbler inserted and the unit turned off.

1. Verify that the therMOstat is off and the bubbler is inserted.
2. Fill the fill canister to the 10 liter mark with the fluid medium of choice.
3. Close the vent valve. Do not overfill the fill canister!
4. Connect fill-hose to the fill/drain coupling on front of the therMOstat.
5. Pressurize canister with hand pump.
6. Press the canister trigger to pump the mixture into the therMOstat module.
7. Continue to slowly pump fluid into the therMOstat until the fluid almost reaches the “Full” level as seen on the front of therMOstat.
8. Release the fill-canister trigger and disconnect the fill-hose
9. While unit is in operation, fluid level will drop. Ensure that fluid level is filled sufficiently such that fluid is visible while in operation.

Pump Priming Procedure

Once the unit has been filled, the pump must be manually primed to purge all remaining air from the process loop.

1. Immediately after filling, turn the system on with the rocker switch on the front of the unit.
2. Place the unit in RUN mode for 10 seconds.
3. Then place the unit in IDLE mode for 10 seconds.
4. Repeat steps 2 and 3 (5) times.
5. System is now ready for constant operation.

Drain Procedure

1. Turn the therMOstat off.
2. Raise the therMOstat above the fill canister.
3. Depressurize the fill canister by opening the vent valve (turn clockwise until it latches open)
4. Connect the fill tube to the drain coupling on the therMOstat.
5. Press the fill-canister trigger to drain the fluid into the canister.

Chapter 4 - Cable Connections

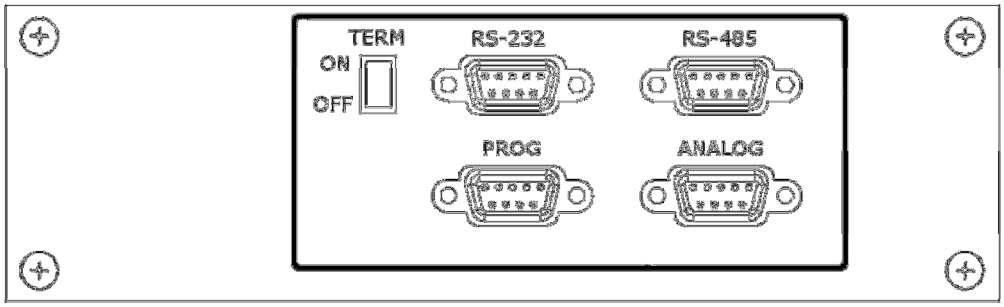


*Figure **4-1** Communications plate sans DeviceNet.*

1. RS 485 termination switch (Up is on, Down is off)
2. RS-232 communication port
3. RS-485 communication port
4. Analog communication
5. Noah Precision service port

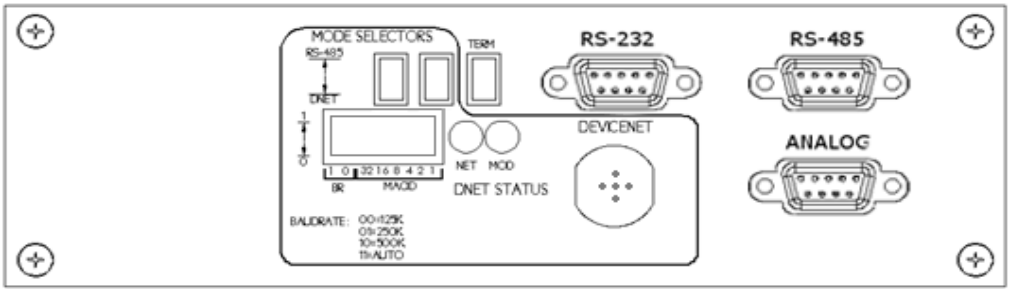


*Figure **4-2** Communications plate with DeviceNet.*

Chapter 5 - Operation

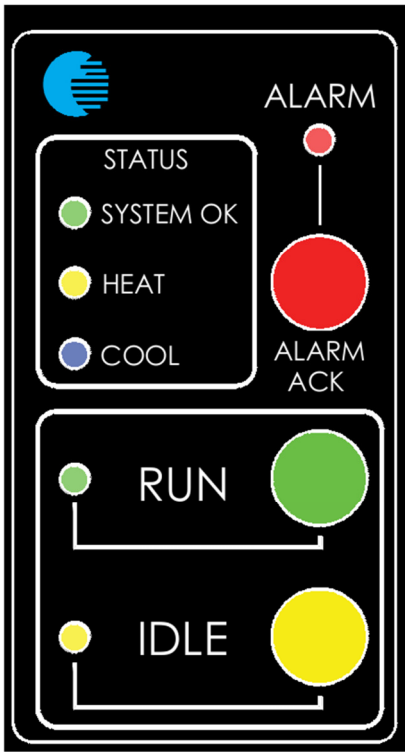


Table 3 Control Panel Indicators

LED Name	Color	Description
System OK	Green	Active during normal operation
Alarm	Red	Active when an alarm condition is met.
Heat	Yellow	Active when TE array is heating process water in bath.
Cool	Blue	Active when TE array is cooling process water in bath.
Run	Green	Active when bath temperature is being actively controlled.
Idle	Yellow	Active when bath temperature is not being actively controlled.

Table 4 Watlow Controller description

Description	Functionality
Upper Display	In the Operations Menu, displays the process value, otherwise displays the value of the parameter in the lower display
Output Activity	Number lights indicate activity of outputs 1 and 2.
Communications Activity	Flashes when another device is communicating with this controller
Up and Down Keys	In the Operations Menu, adjusts the set point in the lower display. In other pages, changes the upper display to a higher or lower value, or changes a parameter selection.
Infinity Key	Clears and silences alarms, press to back up one level, or press and hold for two seconds to return to the Operations Menu.
Lower Display	Indicates the set point or output power value during operation, or the parameter whose value appears in the upper display.

OPERATIONAL STATES

Upon power on, the system operates in Idle mode until the Run button is pressed.

Idle mode

Pump and TE are disabled, but the controller is active and monitors temperature and alarms. The system is put into the Idle state manually (through a switch) or goes into it during a hard alarm condition.

Active mode

Pump and TE supplies are enabled, and the controller actively maintains temperature setpoint.

FRONT PANEL

There are three functional items on the front panel of the therMOstat 500, see *Figure **1-2***), these include:

- Power Switch – toggles the system on/off
- Fill Port – Drains or fills the bubbler bath.
- Fluid Level – Indicates if bubbler-bath fluid level is within acceptable range.

SYSTEM START-UP

Step-by-step instructions for normal operation:

1. Turn the Power switch on. Control panel and Watlow controller should turn on in idle state.
2. Press the Run button on the control panel.
3. Program the set-point temperature by using the Up and Down arrow keys on the controller. The set-point temperature is shown as the lower number in the controller display.
4. Press the Run button to enable temperature control. The process fluid temperature is indicated by the upper number in the controller display.
5. If there are no alarm conditions, the green System On LED will light up.
6. If there is an alarm condition, the red Alarm LED will light up.

CONTROLLER SETUP/OPERATION

The controller is set up from the factory with the parameter values listed in Table 5. It may become necessary to change some of these values in order to optimize temperature control.

Press the Advance button to enter the Operations page and scroll through the parameters. A parameter name will appear on the lower display, and its setting or value will appear in the upper display.

Use the Up and Down arrow keys to change a parameter setting. After changing a setting, continue to scroll through the other parameters using the Advance button or press the Infinity button to return to the home page at any time. The home page shows the actual temperature reading and the setpoint.

Table 5 Watlow Controller Operation Parameters

Display	Parameter Name	Default Setting	Range
i.CA1	Calibration Offset	0.0	-1110.55 to 5555.00 ºC
Ad.1	RS-485 Address	1	1-247
o.CA3	Analog Calibration Offset	0.0	-1110.55 to 5555.00 ºC
h.Pb1	Heat Proportional Band	2.8	-1110.55 to 5555.00 ºC
C.Pb1	Cool Proportional Band	1.4	-1110.55 to 5555.00 ºC
ti1	Time Integral	240	0 to 9999 sec per repeat
td1	Time Derivative	40	0 to 9999 sec
db1	Dead Band	0.00	-556 to 556 ºC
AUt	Autotune Request	no	No or Yes
h.Pr1	Heat Power	Info only	0-100%
c.Pr1	Cool Power	Info only	0-100%

Parameter Descriptions:

Calibration Offset

This is used to program in a temperature offset value to the controller's RTD temperature reading (shown in the upper display of the controller screen).

To calibrate the RTD to a reference temperature, record the difference between the controller's reading and a reference sensor's reading. If the controller's reading is lower than the reference sensor's, enter the difference as a positive value into the Calibration Offset parameter using the Up and Down arrow keys. If the controller reading is higher than the reference sensor's, enter the difference as a negative value.

RS-485 Address

This denotes the address of the system when communicating in RS-485 mode. If this setting is changed, the unit must undergo a full power cycle for this change to come into effect.

Analog Calibration Offset

Similar to the calibration offset, this calibrates the voltage signal coming from the analog communication port.

Heat Proportional Band

Sets the PID proportional band for the heat output

Cool Proportional Band

Sets the PID proportional band for the cool output

Time Integral

Sets the PID integral for the heat and cool outputs

Time Derivative

Sets the PID derivative time for the heat and cool outputs

Dead Band

Sets the offset to the proportional band

Autotune Request

Start an Autotune to calculate PID values if the default settings or manual tuning results in poor temperature control. For the majority of applications the default PID settings work well and can easily be adjusted manually if temperature control needs to be optimized – see manual tuning procedure on the next page.

Heat power

Heat output level

Cool power

Cool output level

MANUAL TUNING PROCEDURE FOR THE CONTROLLER

If the default PID parameters do not effectively maintain setpoint, the PID values can be adjusted to compensate. There are two sets of PID values, one for heating and one for cooling. The proportional band settings are independently adjustable for heat and cool, but the same values for time integral and derivative are used for both sets.

The PID parameters are accessed through the Operations page, see *Table 5*, and adjusted using the Up and Down arrow keys.

Manual-tune controller procedure

1. Enter a temperature setpoint.
2. Monitor the temperature response as setpoint is reached.
3. If the temperature fluctuates around the setpoint, increase the Heat and/or Cool proportional bands until the temperature stabilizes.
4. When the temperature has stabilized, it may be at a point other than the setpoint. The difference between the setpoint and temperature can be eliminated with integral control. Decrease the integral setting until the temperature reaches setpoint. If the temperature becomes unstable, increase the integral value until it becomes stable.
5. Change the setpoint by 15 ºC and monitor the temperature approach to setpoint. If the temperature overshoots the setpoint and the overshoot value is undesirable, increase the derivative value. Go back to the original setpoint and try the new value, if necessary. If this value is increased too much, the approach to the setpoint may be too sluggish. Repeat the adjustment as necessary until the temperature approaches setpoint without sluggishness or excessive overshoot.

SETTING DEVICENET ADDRESS AND BAUD RATE

DeviceNet setup instructions are available upon request.

CONFIGURING 485 / MODBUS ADDRESSING

1. Address can be changed by accessing the Ad.1 setting on the home screen of the controller.
2. Using the UP and DOWN keys, this number can be changed from the default (1) to the desired address.
3. Press the green Advance key (button below the ∞ key) on the controller until the home screen is displayed.
4. Unit must be shut down, and all status indicator lights must fully turned off after changing the address.
5. Once the unit is powered on, the address change will be in effect.

ANALOG VOLTAGE OUTPUT FUNCTION

Signal Interface

The signal connector is a 9 pin D-sub female. It is located in the rear of the unit (circled in red in the picture below).

Pin Out

Table 6 Pin out description

Pin Number	Signal Description	Signal Type
1	Chiller Bath Temperature	Analog voltage output, 10 mV/ºC
3	Chiller Bath Temperature Return	Signal Ground (0 V reference)

Calibrating the Analog Voltage Output Signal

The voltage output signal represents the chiller bath using this scale: 10 mV/ºC. For example, if the bath temperature is 17.0C the output voltage will be 0.170 volts.

If the voltage value (or temperature reading of the host tool) does not correspond exactly to the chiller temperature value the voltage signal can be offset to match by following the procedure below:

1. Observe the temperature of the chiller bath on the upper line of the controller display (see *Table **4** Watlow Controller description*). When it is stable go to step 2.

2. Access the o.CA3 screen from the home menu by pressing the Advance key.

3. Using the UP and DOWN keys, the offset can be changed.

*Figure **5-1** Calibration Offset*

*Figure **5-1** Calibration Offset* shows a calibration offset value of 0.00 ºC. Use the UP or DOWN arrow keys to enter a value so that the voltage output (or tool temperature conversion reading) corresponds to the bath temperature.

For example:

If the bath temperature is 17.00 ºC but the output voltage value is 0.174 V (temperature conversion = 17.4 ºC), enter a calibration value of -0.40 ºC so that the output voltage will match the bath temperature reading.

If the voltage value is lower than desired, then enter a positive value equal to the difference between the actual temperature and temperature conversion value.

When done with calibration, press the ∞ key repeatedly until the home page is displayed.

DEVICENET OPERATION

The two toggle switches (Mode Selector) should be in the DOWN position for DeviceNet operation. (The UP position is for RS485)

The baud rate selection (BR) should match the baud rate of the network or can be set for AUTO Detect as noted on silkscreen just below the switch. The baud rate is selectable at 125Kb(00), 250Kb(01), 500Kb(10) or Auto Detect(11).

The MACID needs to be set for the specific channel ID of this specific TMO500 in the network. The MACID can go from 0 to 63.

DeviceNet Status is determined by the two LEDs labeled NS (Node Status) and MS (Module Status). These are bi-color LEDs that indicate a non-error condition by GREEN illumination and error by RED illumination.

DeviceNet Scanner Status / Error Codes

The bicolor (GREEN/RED) Module Status(MS) indicator displays device status. It indicates whether the device has power and is functioning properly.

Table 7 – DeviceNet Module Status (MS) light table.

LED INDICATOR	Means	Action Needed
Off	There is no power applied to the device	Apply power.
Green	The device is operating in normal condition	N/A
Flashing Green	The device needs configuring	Configure the device
Flashing Red	There is an invalid configuration.	Verify dip switch settings. Check configuration setup.

The Network Status (NS) indicator is a bicolor (GREEN/RED) LED. The following table provides troubleshooting information about communication links.

Table 8 – DeviceNet Network Status (NS) light table.

LED INDICATOR	Means	Action Needed
Off	There is no power applied to the device	Apply power.
Green	The device is operating in normal condition	N/A
Flashing Green	The device needs configuring	Configure the device
Red	Communication Channel Failure	Verify dip switch settings. Check configuration setup.
Flashing Red	There is an invalid configuration.	Verify dip switch settings. Check configuration setup.

Chapter 6 - Maintenance

The TMO-500 chiller does not require daily maintenance if used in conjunction with the correct sizing kit. However, it is necessary to prevent buildup of any minerals, salts, or algae within the system's tank. These contaminants can cause issues in the vein of early component failures, improper alarms, or even complete loss of temperature control.

It is therefore recommended that every month, or every bubbler change at minimum, the water is drained completely from the system and refilled with fresh distilled/deionized water for operation. No other maintenance is required if this schedule is adhered to.

Chapter 7 - Troubleshooting

TYPES OF ALARMS

Soft Alarm

A soft alarm is informative only and does not affect the temperature control capability of the system. A soft alarm condition occurs when the alarm light is illuminated but remains in Run mode. This will happen when the system is running low on fluid. The system should be refilled as soon as possible.

A soft alarm is not latching and will clear itself once the alarm condition is taken care of. Soft alarm presence is dependent on TMO revision.

Hard Alarm

A hard alarm will put the system into the Idle state by disabling the pump and TE. A hard alarm condition occurs when the buzzer emits a tone and the therMOstat switches into Idle mode. Additionally, this type of alarm will cause the controller to signal the host tool, through RS-485, RS-232, and DeviceNet, that this condition is active.

A hard alarm is latching. After taking care of the alarm condition, the Run button will need to be pressed to reset the system.

TROUBLESHOOTING

This section discusses the following topics to help troubleshoot any problems that might occur when operating either unit. A troubleshooting guide is provided in Table 9. If following these procedures does not solve the problem, do not hesitate to call Noah Precision Customer Support (displayed later on in this chapter).

Troubleshooting Guide

DANGER:
High voltage is active in the system. Safety covers provide protection for the user and the machine. If bypassed, only authorized and qualified personnel should repair or test the system.

Table 9 Troubleshooting Guide

Symptom	Probable Cause	Corrective action
Hard alarm – system goes into idle mode.	1. Liquid Level is too low for operation. 2. Tank or PCW temperature exceeds spec. 3. Pump is inoperative 4. Power Supply failure	1. Add fluid until liquid level indicator is within Low and Full bounds. 2. Check that PCW flowrate and temperature is within specifications. 3. Replace or troubleshoot pump. 4. Replace Power Supply.
Soft Alarm – Alarm light is active, but system remains in run mode.	1. Liquid level is low.	1. Add fluid until liquid level indicator is within Low and Full bounds
System won't reach temperature setpoint	1. System in Idle mode. 2. PID parameters are not properly tuned for the process. 3. TE array is inoperative	1. Switch to Active mode. 2. Manually tune PID parameters. 3. Repair technician to preform inspection.
RS-485 communication is intermittent	1. Last module in RS-485 chain is not terminated correctly.	1. Flip communication-termination toggle to the on position, on the last chiller in the communication bus. All other modules should have termination off.
Unit does not power on when power switch is toggled to on.	1. AC Power source does not meet specification. 2. Check power plug connection between therMOstat 500 and cabinet. 3. Fuse is blown	1. Check that power meets requirements. 2. Check power cable connection. 3. Replace fuse located in the fuse drawer on the power plug, see *Figure* **4-1**.

Noah Precision World Wide Web Site

For additional product information, consult Noah Precision's World Wide Web site at *http://www.noahprecision.com*

NOAH PRECISION CUSTOMER SUPPORT

Please contact one of the following offices in Table 10 for technical support.

Note: When calling Noah Precision Customer Support, make sure to have the unit serial number and part number. These numbers are available on the individual unit labels.

Table 10 Customer Support locations

Office	Contact
Noah Precision, LLC 2501 SE Columbia Way Suite 140 Vancouver, WA 98661	Phone: +1 360 993 1395 Fax: +1 360 993 1399 Email: sales@noahprecision.com service@noahprecision.com Web:*http://www.noahprecision.com*
China – Challenge Technology Shanghai	Phone: 86 21 6847 1388 Fax: 86 21 6847 1339
Taiwan – Challentech International Corp.	Phone: 88 63 5536525 Fax: 88 63 5536515

RETURNING UNITS FOR REPAIR

Detailed information regarding returns, repairs and warranty can be found at:
http://www.noahprecision.com/rma-information.html

An RMA Request Form can be completed at:
http://www.noahprecision.com/support/form_RMA.php

BEFORE returning any product for repair or adjustment, **follow all troubleshooting procedures**. If, after following these procedures, the problem still exists, or if the procedure instruction advises contacting Noah Precision Customer Support, call and discuss the problem with a representative or visit the links listed above. Be prepared to give the model number and serial number of the unit, as well as the reason for the proposed return. This consultation call allows Noah Precision Customer Support to determine whether the problem can be corrected in the field or if the unit must be returned. Such technical consultation is always free of charge.

If a unit is returned without first getting authorization from Noah Precision Customer Support and that unit is found to be functional, there is a re-test and calibration fee plus shipping charges.

To ensure years of dependable service, Noah Precision products are thoroughly tested and designed to be among the most reliable and highest quality systems available worldwide.

WARRANTY

Noah Precision, LLC products are warranted to be free from failures due to defects in material and workmanship after they are shipped from the factory (please see warranty statement below, for details) for the period of time defined in the purchase order.

To claim shipping or handling damage, inspect the delivered goods and report such damage to Noah Precision within 30 days of receipt of the goods. Please note that failing to report any damage within this period is the same as acknowledging that the goods were received undamaged.

For a warranty claim to be valid, it must:

- Be made within the applicable warranty period
- Include the product serial number and a full description of the circumstances giving rise to the claim
- Have been assigned return material authorization number (see below) by Noah Precision Customer Support

All warranty work will be performed at an authorized Noah Precision service center (see list of contacts at the beginning of this chapter). You are responsible for obtaining authorization to return any defective units, prepaying the freight costs, and ensuring that the units are returned to an authorized Noah Precision service center.

Warranty Statement

The seller makes no express or implied warranty that the goods are merchantable or fit for any particular purpose except as specifically stated in printed Noah Precision specifications. The sole responsibility of the Seller shall be that it will manufacture the goods in accordance with its published specifications and that the goods will be free from defects in material and workmanship. The seller's liability for breach of an expressed warranty shall exist only if the goods are installed, started in operation, and tested in conformity with the seller's published instructions. The seller expressly excludes any warranty whatsoever concerning goods that have been subject to misuse, negligence, or accident, or that have been altered or repaired by anyone other than the seller or the seller's duly authorized agent. This warranty is expressly made in lieu of any and all other warranties, express or implied, unless otherwise agreed to in writing. The warranty period is defined in the purchase order and begins on the date the goods are shipped from Noah Precision. In all cases, the seller has sole responsibility for determining the cause and nature of the failure, and the seller's determination with regard thereto shall be final. The Noah Precision Warranty Statement may be superseded by a service agreement entered into between Noah Precision and the buyer.